CLAIMS

1. A living-tissue pattern detecting method wherein the roughness distribution pattern of deep-layer tissue of skin covered with epidermal tissue is detected for extracting a unique pattern of living tissue.

2. A living-tissue pattern detecting method according to Claim 1, wherein said deep-layer tissue of the skin is dermal tissue.

3. A living-tissue pattern detecting method according to Claim 1, wherein said roughness distribution pattern is optically detected using difference in optical properties between said epidermal tissue and said deep-layer tissue of the skin.

4. A living-tissue pattern detecting method according to Claim 3, wherein polarized light is cast on said tissue, and reflected light is detected through a polarizing filter with a polarizing plane orthogonal to that of said polarizing light, for detecting said roughness distribution pattern.

5. A living-tissue pattern detecting method according to Claim 4, wherein long-wavelength light is used as said polarizing light.

6. A living-tissue pattern detecting method according to Claim 5, wherein near-infrared light is used as said long-wavelength light.

7. A living-tissue pattern detecting method according to Claim 4, wherein wavelength components changed due to reflection are selected by means which allow light with a predetermined frequency to pass through, or means which reflect light with a predetermined frequency.

8. A living-tissue pattern detecting method according to Claim 4, wherein incident angle of said polarized light is controlled so as to adjust the depth for detecting the object which is to be detected.

9. A living-tissue pattern detecting method according to Claim 3, wherein illumination light is cast onto said tissue so as to cause interference between a part of said illumination light and reflected light for detecting change in wavelength components of the reflected light in the form of an interference pattern, thereby extracting a unique pattern of living tissue.

10. A living-tissue pattern detecting method according to

Claim 1, wherein said roughness distribution pattern is electrically detected using difference in electric properties between epidermal tissue and deep-layer tissue of the skin.

11. A living-tissue pattern detecting method according to Claim 10, wherein the electric potential of the skin is measured using electrostatic induction so as to detect the depth at which dermal tissue beneath epidermis is positioned, thereby detecting the tissue structure beneath epidermis.

12. A living-tissue pattern detecting method according to Claim 11, wherein a plurality of fine electrodes are arrayed in parallel at a predetermined pitch for being fit to the skin which is to be detected.

13. A living-tissue pattern detecting method according to Claim 12, wherein capacitance coupling is formed between each fine electrode and dermal tissue, and distance distribution regarding the conductive layer beneath epidermis is calculated based upon electrostatic capacitance thus formed underneath each fine electrode, thereby detecting said tissue structure beneath the epidermis.

14. A living-tissue pattern detecting method according to

Claim 13, wherein said fine electrodes each of which are stored in a metal casing through an insulating member are disposed at a predetermined pitch, and said metal casing includes a dielectric thin film for being fit to the skin so as to be introduced between said metal casing and the skin.

15. A living-tissue pattern detecting method according to Claim 13, wherein an electret film is provided on the surface of said fine electrode, and electrostatic capacitance is formed between said fine electrode and dermal tissue with a bias voltage due to permanent polarization of said electret film.

16. A living-tissue pattern detecting method according to Claim 12, wherein change in charge on living tissue due to motions is detected with said fine electrode, and difference in the amplitude of waveforms due to change in charge between said fine electrodes is converted into distance between the surface of the skin and tissue beneath epidermis.

17. A living-tissue pattern detecting device including means for detecting the roughness distribution pattern of deep-layer tissue of skin covered with epidermal tissue.

18. A living-tissue pattern detecting device according to

Claim 17, wherein said means for detecting said roughness distribution pattern have a function for optically detecting said roughness distribution pattern.

19. A living-tissue pattern detecting device according to Claim 18, comprising: an illumination optical system including a light source for casting light onto a portion which is to be detected, and a polarizing filter for aligning the polarizing plane of illumination light; and an imaging optical system including a light-receiving unit for receiving reflected light from said portion which is to be detected, and a polarizing filter with a polarizing plane orthogonal to that of said polarizing filter.

20. A living-tissue pattern detecting device according to Claim 19, wherein said light source comprises a near-infrared light source.

21. A living-tissue pattern detecting device according to Claim 19, further comprising means for selecting wavelength components of said reflected light, changed due to reflection.

22. A living-tissue pattern detecting device according to Claim 19, further comprising a moving reflecting mirror for

controlling the incident angle of light cast from said light source.

23. A living-tissue pattern detecting device according to Claim 18, comprising: an illumination optical system including a light source for casting light onto a portion which is to be detected; a reference optical system for causing an interference pattern for detecting change in wavelength components of the reflected light; and an imaging optical system for detecting said interference pattern.

24. A living-tissue pattern detecting device according to Claim 23, wherein said light source comprises a white light source.

25. A living-tissue pattern detecting device according to Claim 23, wherein a plurality of detecting units each of which includes said illumination optical system, said reference optical system, and said imaging optical system, are arrayed.

26. A living-tissue pattern detecting device according to Claim 23, further comprising a moving mirror for controlling the incident position at which light is cast from said light source.

27. A living-tissue pattern detecting device according to Claim 17, wherein said means for detecting the roughness distribution pattern have a function for electrically detecting the roughness distribution pattern.

28. A living-tissue pattern detecting device according to Claim 27, wherein the electric potential of the skin is measured using electrostatic induction for detecting the depth at which dermal tissue beneath epidermis is positioned, thereby detecting tissue structure beneath epidermis.

29. A living-tissue pattern detecting device according to Claim 28, further comprising a plurality of fine electrodes arrayed in parallel at a predetermined pitch upon the skin which is to be detected, wherein the distance distribution regarding a conductive layer beneath epidermis is calculated based upon electrostatic capacitance underneath each fine electrode, thereby detecting the tissue structure beneath epidermis.

30. A living-tissue pattern detecting device according to Claim 29, wherein said fine electrodes each of which are stored in a metal casing through an insulating member are arrayed at a predetermined pitch, and wherein said metal

casing includes a dielectric thin film to be introduced between said metal casing and the skin.

31. A living-tissue pattern detecting device according to Claim 29, wherein each fine electrode includes an electret film on the surface thereof.

32. A biometric authentication method wherein the roughness distribution pattern of deep-layer tissue of the skin covered with epidermal tissue is detected, and said roughness distribution pattern thus detected is compared to a pattern which has been registered beforehand, whereby biometric authentication is performed.

33. A biometric authentication method according to Claim 32, wherein said deep-layer tissue of the skin is dermal tissue.

34. A biometric authentication method according to Claim 32, wherein said roughness distribution pattern is optically detected using difference in optical properties between said epidermal tissue and said deep-layer structure of the tissue.

35. A biometric authentication method according to Claim 34, wherein polarized light is cast on said tissue, and

reflected light is detected through a polarizing filter with a polarizing plane orthogonal to that of said polarizing light, for detecting said roughness distribution pattern.

36. A biometric authentication method according to Claim 34, wherein illumination light is cast onto said tissue so as to cause interference between a part of said illumination light and reflected light for detecting change in wavelength components of the reflected light in the form of an interference pattern, thereby extracting a unique pattern of living tissue.

37. A biometric authentication method according to Claim 32, wherein a fork structure of a subcutaneous blood vessel is used as the portion which is to be detected, and wherein said portion which is to be detected and the direction of the principal axis are determined at the time of authentication, based upon said fork structure using the relation between said principal axis and said fork structure registered beforehand.

38. A biometric authentication method according to Claim 37, wherein living-tissue discrimination is made using said subcutaneous blood vessel.

39. A biometric authentication method according to Claim 38, wherein living-tissue discrimination is made using change in absorbance due to change in blood flow in said subcutaneous blood vessel.

40. A biometric authentication method according to Claim 32, wherein said roughness distribution pattern is electrically detected using difference in electric properties between epidermal tissue and deep-layer tissue of the skin.

41. A biometric authentication method according to Claim 40, wherein the electric potential of the skin is measured using electrostatic induction so as to detect the depth at which dermal tissue beneath epidermis is positioned, thereby detecting the tissue structure beneath epidermis.

42. A biometric authentication method according to Claim 32, wherein the tissue structure beneath epidermis covered with epidermal tissue is detected using difference in temperature between epidermal tissue and deep-layer tissue of the skin.

43. A biometric authentication method according to Claim 42, wherein fine temperature detecting devices are arrayed,

and wherein said tissue structure beneath epidermis is detected based upon difference in temperature between said temperature detecting devices.

44. A biometric authentication method according to Claim 43, wherein said difference in temperature is detected in the form of difference in magnitude of infrared light.

45. A biometric authentication device including means for detecting the roughness distribution pattern of deep-layer tissue of the skin covered with epidermal tissue, wherein said roughness distribution pattern thus detected is compared to a pattern which has been registered beforehand, whereby biometric authentication is performed.

46. A biometric authentication device according to Claim 45, wherein said means for detecting the roughness distribution pattern has a function for optically detecting said roughness distribution pattern.

47. A biometric authentication device according to Claim 46, comprising: an illumination optical system including a light source for casting light onto a portion which is to be detected, and a polarizing filter for aligning the polarizing plane of illumination light cast from said light

source; and an imaging optical system including a light-receiving unit for receiving reflected light from said portion which is to be detected, and a polarizing filter with a polarizing plane orthogonal to that of said polarizing filter.

48. A biometric authentication device according to Claim 46, comprising: an illumination optical system including a light source for casting light onto a portion which is to be detected; a reference optical system for causing an interference pattern for detecting change in wavelength components of the reflected light; and an imaging optical system for detecting said interference pattern.

49. A biometric authentication device according to Claim 45, including means for determining the position which is to be detected and the direction of the principal axis based upon the structure of a subcutaneous blood vessel.

50. A biometric authentication device according to Claim 49, comprising:

an interference-light detecting unit for detecting the roughness distribution pattern of deep-layer tissue of the skin covered with epidermal tissue;

a moving mirror for controlling the incident angle of

illumination light cast from said interference-light detecting unit;

a blood-vessel position detecting unit for detecting the positions of subcutaneous blood vessels based upon information from said interference-light detecting unit;

a blood-vessel data storage unit for storing an images of subcutaneous blood vessels;

a blood-vessel position comparison unit for comparing the positions of the detected blood vessels to blood-vessel data stored beforehand;

a mirror control unit for controlling the angle of said moving mirror based upon control information from said blood-vessel position detecting unit and said blood-vessel position comparison unit;

an interference-pattern storage unit for storing the interference pattern due to deep-layer tissue of the skin;

a matching unit for performing matching of the positions of blood vessels and said interference pattern; and

an interference-pattern comparison unit for comparing interference-pattern information received from said interference-light detecting unit to the interference pattern stored in said interference-pattern storage unit.

51.   A biometric authentication device according to Claim

45, wherein said means for detecting the roughness distribution pattern have a function for electrically detecting the roughness distribution pattern.

52. A biometric authentication device according to Claim 51, wherein the electric potential of the skin is measured using electrostatic induction for detecting the depth at which dermal tissue beneath epidermis is positioned, thereby detecting tissue structure beneath epidermis.

53. A biometric authentication device according to Claim 52, wherein further comprising a plurality of fine electrodes arrayed in parallel at a predetermined pitch upon the skin which is to be detected, wherein the distance distribution regarding a conductive layer beneath epidermis is calculated based upon electrostatic capacitance underneath each fine electrode, thereby detecting the tissue structure beneath epidermis.

54. A biometric authentication device according to Claim 45, wherein said means for detecting the roughness distribution pattern have a function for detecting tissue structure beneath epidermis covered with epidermal tissue using difference in temperature between said epidermal tissue and said deep-layer tissue of the skin.

55. A biometric authentication device according to Claim 54, including a plurality of temperature detecting devices arrayed upon the skin which is to be detected, wherein the roughness distribution regarding the tissue beneath epidermis is detected based upon difference in temperature between said temperature detecting devices, whereby the tissue structure beneath epidermis is detected.

56. A biometric authentication device according to Claim 54, including a plurality of infrared detecting devices arrayed upon the skin which is to be detected, wherein the roughness distribution regarding the tissue beneath epidermis is detected based upon difference in the magnitude of infrared light between said infrared detecting devices, whereby the tissue structure beneath epidermis is detected.

57. A biometric authentication method wherein near-infrared light is cast onto the tissue through a polarizing filter, as well as detecting reflected light through a polarizing filter with a polarizing plane orthogonal to that of said polarizing filter, so as to detect an image of blood capillaries beneath epidermis or the three-dimensional distribution pattern thereof, and wherein comparison is made between: said image of blood capillaries beneath epidermis

or said three-dimensional distribution pattern thereof thus detected; and a pattern registered beforehand, whereby biometric authentication is performed.

58. A biometric authentication device comprising: an illumination optical system including a light source for casting near-infrared light onto a portion which is to be detected, and a polarizing filter for aligning the polarizing plane of illumination light cast from said light source; and an imaging optical system including an imaging unit for taking an image of reflected light from said portion which is to be detected, and a polarizing filter with the polarizing plane orthogonal to that of said polarizing filter; wherein comparison is made between: an acquired image of blood capillaries beneath epidermis or the three-dimensional distribution pattern thereof; and a pattern registered beforehand, whereby biometric authentication is performed.